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(54) Identification system for stock farms.

(57) An identification system, in particular one suitable for stock farms comprising a transmitter/receiver for generating an electromagnetic interrogation field in a detection zone and for receiving an identification signal generated by a responder; and a plurality of coded responders capable of generating an identification signal in response to an electromagnetic interrogation field, each coded responder being, in operation, attached to a specific animal and being capable of generating an identification signal associated with that animal. According to the invention the coded responders have a relatively small area of operation and can be implanted in an animal. There is further provided for each animal a transponder attachable to such animal, which transponder is, in operation, disposed in the area of operation of the coded responder of the animal, and comprises an electrical circuit which, in response to the interrogation field generated by the transmitter/receiver is capable of generating itself a second interrogation field, which second interrogation field is capable of activating the implantable responder.

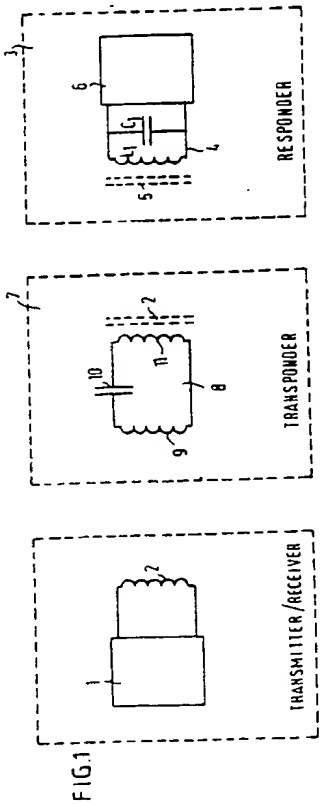

FIG.1

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Identification system for stock farms.

This invention relates to an identification system, in particular one suitable for stock farms, comprising a transmitter/receiver for generating an electromagnetic interrogation field in a detection zone and for receiving an identification signal generated by a responder; a plurality of coded responders capable of generating an identification signal in response to an electromagnetic interrogation field, each coded responder, in operation, being attached to an individual animal and being arranged to generate a unique identification signal associated with such animal.

A system of this kind, and specifically a responder circuit of such a system, is described, for example, in our Dutch patent No. 176,404. A responder provided with such a circuit, when activated by an electromagnetic interrogation field, can generate a unique code, for example, a numerical code, which is converted into an identification signal that can be received by the transmitter/receiver or by a separate receiver. According to a subsequent development, described, for example, in our Dutch patent application 86,01021, such a responder may comprise a reprogrammable memory means, so that the original code can be changed and/or supplemented with new data.

To identify farm animals, for example pigs and cows, earmarks are often used nowadays. In the various stock farming branches, different earmarks are used, which exhibit differences in execution and method of attachment. The nature of the information provided by an earmark may also exhibit differences. In addition to the prescribed earmarks, the animals are mostly additionally provided with an electronic label or responder, which is attached to the animal by means of a collar and serves for the remote identification of animals by various automatic systems, such as systems for feeding, separating, automatic milking and other stock managing systems.

It is an object of the present invention to integrate all identification systems nowadays used into one universal system, in which the animals are provided with a unique life number which can serve for both the identification and registration prescribed by the Government and the remote identification for automatic apparatuses at the farm, on market places, during transport and in the slaughter-house. As earmarks are not infrequently lost, for example by being scraped along obstacles, they do not guarantee a foolproof system in which the life number is indissolubly connected with the animal. In addition, an earmark number is not insensitive to fraud, because it can be transferred to another animal with a greater or lesser amount of effort.

According to the present invention, an identification system of the above kind is characterized in that the coded responders are arranged to be implanted in an animal and to have a relatively small area of operation, and that there is further provided for each animal a transponder, attachable to the animal, and, in operation, being disposed in the area of operation of the coded responder, said transponder comprising an electric circuit which in response to the interrogation field generated by the transmitter/receiver itself generates a second interrogation field, which second interrogation field can activate the implantable responder.

The transponder accordingly serves as an intermediate station effecting the electromagnetic coupling between the transmitter/receiver and the implantable responder. As a consequence, the implantable responder can be made sufficiently small for it to be actually implanted in a simple manner, for example, with a simple injection tool. Such an implantable responder may, for example, be 2 mm in diameter and 15 mm long. It is clear that, with such small dimensions, the coil present in the responder is also very small, so that the area of operation of the responder is small too. As the interrogation field of a remote transmitter/receiver necessarily has a low concentration near the responder, the responder itself is unable to directly influence the interrogation field to a sufficient extent. For this reason the present invention employs an intermediate station, i.e., the transponder, which provides an effective electromagnetic coupling with both the transmitter/receiver and the responder.

The transponder may be attached to the animal, for example, by means of a collar, but may alternatively take the form of an earmark. The information stored in the responder preferably comprises at least the life number of the animal. This life number is advantageously also provided on the outside of the transponder to enable visual inspection.

If the earmark should be lost, from scraping or otherwise, the implanted responder with the life number stored electronically therein will remain, and the coupling to bridge larger distances can be re-established by providing a fresh earmark. Accordingly, the earmarks may be identical in an electrical sense, and differ exclusively in he visual numbers carried by them.

It is noted that the use of an implantable responder is known per se, for example, from Dutch patent application No. 78,10245.

Some embodiments of the invention will now

be described, by way of example, with reference to the accompanying diagrammatic drawings. In said drawings.

Fig. 1 shows an example of apparatus according to the present invention;

Fig. 2 shows a variant of a part of Fig. 1;

Figs. 3-5 show some embodiments of active transponder circuits.

Fig. 1 diagrammatically shows an example of apparatus according to the present invention. As shown, the apparatus comprises a transmitter/receiver 1 comprising a transmission coil 2, by means of which, in operation, an electromagnetic interrogation field can be generated with a pre-determined, suitable frequency. In principle, any transmitter/receiver of an electromagnetic stock identification system can be used. Such identification systems are at present commercially available in various forms from various manufacturers.

Fig. 1 further shows an implantable responder 3 comprising a receiver circuit 4 including a coil L_1 and a capacitor C_1. The coil may be wound on a ferrite rod 5. Receiver circuit 4 is connected to a code circuit 6 comprising active electronic components which in known manner, in operation, receive supply voltage and control signals from the receiver circuit. A suitable responder is described, for example, in US patent 4,196,418.

The responder can only be activated if the field strength of the interrogation field which in operation is generated by the transmitter/receiver is sufficiently high near the responder. This means that the number of field lines comprised by coil L_1 should be sufficiently large for inducing an A.C. voltage across the LC circuit 4 of such a value that the supply voltage required for an effective operation of the active electronic components of the code circuit can be derived from it.

As, according to this invention, the responder takes the form of an implantable responder with minimum outside dimensions, coil L_1 can only comprise a small number of field lines of the interrogation field, if the transmitter/receiver is placed at the usual distance from the animals to be identified.

For this reason, according to this invention, an intermediate station 7 is used which is referred to herein as a transponder. In operation, the transponder is arranged in the vicinity of the implanted responder and, in response to the interrogation field of transmitter/receiver 1 generates a sufficiently strong field near the responder coil L_1 to activate the responder. For this purpose the transponder itself should have a receiver coil large enough to comprise a large number of field lines of the interrogation field.

In the example shown, transponder 7 comprises an LC circuit with a receiver coil 9, a capacitor 10 and a second coil 11 which may be provided with a ferrite rod 12 and is capable of transmitting energy to the receiver circuit 4 of the responder electromagnetically, i.e., in a wireless manner. Like circuit 4, circuit 8 is tuned to the frequency of the transmitter/receiver. Similarly, the identification signals generated by responder 3 can be transmitted through transponder 7 to the transmitter/receiver.

The responders to be implanted preferably comprise a housing made of a material, or provided with a layer of material, which after implantation coalesces with the animal tissue. This discourages the fraudulent removal of the responder, and further promotes that the responder remains at the position originally selected for it. Suitable materials are polyethylene vinyl acetate (EVA), PMMA, a layer of Teflon (a registered trademark), and silicone rubber.

The transponder may be attached to an animal in various ways. Thus, for example, the transponder may be made similarly to the conventional collar transponders. The transponder may alternatively take the form of an earmark. The responder is then implanted in the animal's ear.

In all cases the transponder may advantageously be provided with a visual marking of the identity of the animal, e.g., its life number.

The code circuit 6 of the responder preferably also contains the life number or a similar unique identifying indication. If desired, additional information may be contained in the code circuit. Such other information may or may not be variable by wireless means.

In case the transponder is damaged or becomes lost, the implanted responder can be activated, if necessary, by means of a special transmitter/receiver to be hand carried in the vicinity of the responder to determine its code. The provision of a new transponder, too, is in principle a very simple matter, as all transponders may be identical both electrically and mechanically.

It is noted that, as an alternative, the transponder could comprise a single coil. Such a single coil may or may not be provided with a ferrite rod.

Fig. 2 diagrammatically shows such a transponder 7' with a single coil 14 and a ferrite rod 15.

Furthermore, if desired, it is possible for the transponder to be provided with an active electronic circuit supplied with energy from a battery. The transponder can then function as an active amplifier in the path between transmitter/receiver and responder. In that case the transponder is preferably designed so that it is only activated in the presence of an interrogation field with the correct frequency. In this way the battery is only switched on when actually needed. As the tran-

sponder is easy of access, the battery may be mounted so as to be replaceable.

Advantageously, the active transponder may be arranged so that when the battery is exhausted, the transponder operates in the passive mode described before.

One embodiment of an active transponder is shown diagrammatically in Fig. 3. As shown, the transponder circuit comprises an input circuit L_2C_2, an amplifier 20 and an output circuit L_3C_3. The input circuit effects the electromagnetic coupling with the interrogation field, and the output circuit serves for the electromagnetic coupling with the responder. The amplifier 20 receives supply voltage from battery 21. The circuit arrangement is such in this example that the battery is only connected to the supply terminals of the amplifier if the transponder is in an interrogation field with the correct frequency and with a sufficient strength. In this manner the service life of the battery is considerably prolonged. The frequency selection takes place automatically as the input circuit L_2C_2 is a resonance circuit attuned to the frequency of the interrogation field. The voltage induced across the resonance circuit is compared by means of a comparator 22 with a predetermined fixed threshold value. As soon as the threshold value is exceeded, a switching device 23 is closed, and the amplifier is provided with supply voltage, so that the input signal appears across the output circuit in an amplified value.

Fig. 4 shows a further elaboration of Fig. 3, in which comparator 22 and switch 23 take the form of a rectifier, in this case a single diode 24, which rectifies the voltage induced across receiver circuit L_2C_2, and passes it to a control electrode of a semiconductor switch 25, such as a transistor or a thyristor. As soon as the voltage on the control electrode exceeds a pre-determined value, the switch is closed.

It is noted that an electromagnetic coupling can be effected between L_2 and L_3, which may lead to oscillations in the transponder. To prevent such oscillations, coils L_2 and L_3 should be so disposed relatively to each other as to exclude their being electromagnetically coupled. For this purpose, for example, the coils may be mounted transversely to each other.

Alternatively, the transponder circuit may be allow to oscillate. In that case, however, a timer should be used to terminate the oscillation effect after a pre-determined time interval.

Fig. 5 shows a transponder circuit provided with a timer 26, in which, at the same time, the output circuit is combined with the input circuit, so that only a single circuit $L_2'C_2'$ is present. The timer may, for example, comprise a Schmitt trigger, or a binary counter which after a pre-determined time interval breaks the connection between battery 24 and amplifier 20.

It is noted that, if desired, the transponder may be provided with a code circuit which may or may not be re-programmable, similarly to the coded responders of the prior art. The code of such a coded transponder may or may not correspond, either in full or in part, with the code recorded in the implanted responder.

It is possible to use a coded transponder for all ordinary or usual identification purposes and the implanted responder only in particular circumstances, for example, when the transponder is damaged or if it is desired to check the code of the transponder, in which case it can be read with an interrogation field generated in the vicinity of the responder.

These and similar modifications will readily occur to those skilled in the art after reading the foregoing, and are to be considered as falling within the scope of the present invention.

Claims

1. An identification system, in particular one suitable for stock farms, comprising a transmitter-receiver for generating an electromagnetic interrogation field in a detection zone and for receiving an identification signal generated by a responder; and a plurality of coded responders capable of generating an identification signal in response to an electromagnetic interrogation field, each coded responder being, in operation, attached to a specific animal and being capable of generating an identification signal associated with that animal, characterized in that the coded responders take the form of responders with a relatively small area of operation, adapted to be implanted in an animal, and that further there is provided for each animal a transponder attachable to such animal, which transponder is, in operation, disposed in the area of operation of the coded responder of the animal, and comprises an electrical circuit which, in response to the interrogation field generated by the transmitter-receiver is capable of generating itself a second interrogation field, which second interrogation field is capable of activating the implantable responder.

2. An identification system as claimed in claim 1, characterized in that at least one transponder is provided with a visual identifying indication.

3. An identification system as claimed in claim 1 or 2, characterized in that at least one transponder takes the form of an earmark.

4. An identification system as claimed in claim 1 or 2, characterized in that at least one transponder is provided with a collar for an animal to be identified.

5. An identification system as claimed in any of the preceding claims, characterized in that the electrical circuit of the transponders is a passive circuit comprising at least one coil tuned to the interrogation field.

6. An identification system as claimed in any of claims 1-4, characterized in that the electrical circuit of the transponder comprises a tuned circuit with at least one coil mounted on a ferrite rod.

7. An identification system as claimed in any of claims 1-4, characterized in that the electrical circuit of at least one transponder comprises a battery-fed active amplifier circuit.

8. An identification system as claimed in claim 7, characterized by detection means provided in said at least one transponder, said detection means being activated by an interrogation field with a predetermined frequency to effect an electric coupling of the battery with the amplifier circuit.

9. An identification system as claimed in claim 7 or 8, characterized in that said at least one transponder is arranged so that with an exhausted battery it operates as a passive responder.

10. An identification system as claimed in any of the preceding claims, characterized in that the coded responders are arranged so that the code of the coded responders is at least partially reprogrammable by wireless means.

11. An identification system as claimed in any of the preceding claims, characterized in that the implantable responders are mounted in a housing whose outer surface consists of a material capable of coalescing with the tissue of the animal.

12. An identification system as claimed in any of the preceding claims, characterized in that at least one transponder is provided with its own code circuit which under the influence of a suitable interrogation field generates a code signal.

13. An identification system, in particular one suitable for stock farms, comprising a transmitter/receiver for generating an electromagnetic interrogation field in a detection zone and for receiving an identification signal generated by a responder; and a plurality of coded responders capable of generating an identification signal in response to an electromagnetic interrogation field, each coded responder being, in operation, attached to a specific animal and being capable of generating an identification signal associated with that animal, characterized in that the coded responders are formed as miniaturized responders with a relatively small area of operation, which are implantable in an animal, and that furthermore an additional coded responder is provided for each animal for attachment to such animal, which additional responder is arranged to generate an identification signal in response to the interrogation field.

14. An identification system as claimed in any of claims 7-13, characterized in that said at least one responder comprises a first LC circuit acting as an input circuit, and a second LC circuit acting as an output circuit, the input circuit being connected to the input of the amplifier, and the output circuit being connected to the output of the amplifier; and that the detection means comprise a threshold value detector connected to the input circuit.

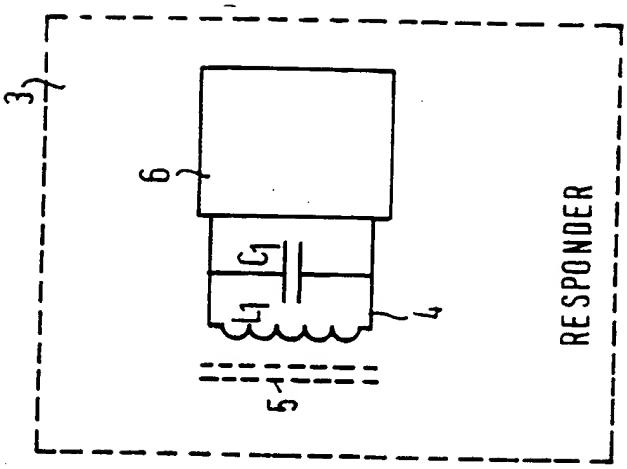
15. An identification system as claimed in claim 14, characterized in that the connection between the battery and one of the supply terminals of the amplifier comprises a semiconductor switch element with a control electrode.

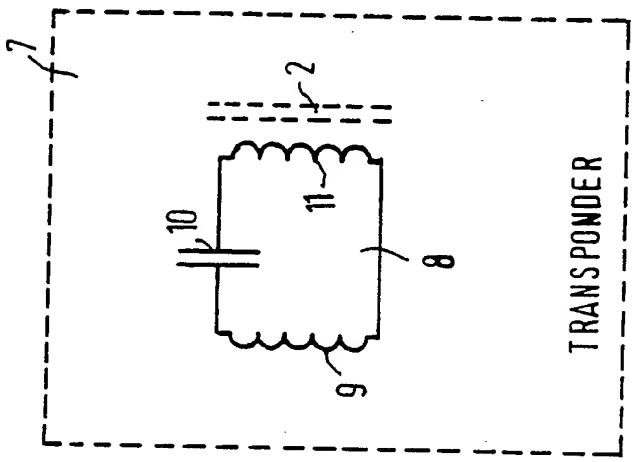
16. An identification system as claimed in claim 15, characterized in that the control electrode is connected through a rectifier to the input circuit.

17. An identification system as claimed in any of claims 14-16, characterized in that the input circuit and the output circuit have at least one coil in common.

18. An identification system as claimed in any of claims 14-17, characterized by the provision of a timer in the connection between the battery and the amplifier, which timer breaks the connection after a pre-determined time interval.

19. An identification system as claimed in claim 18, characterized in that the timer also functions as a threshold value detector and as a switch.





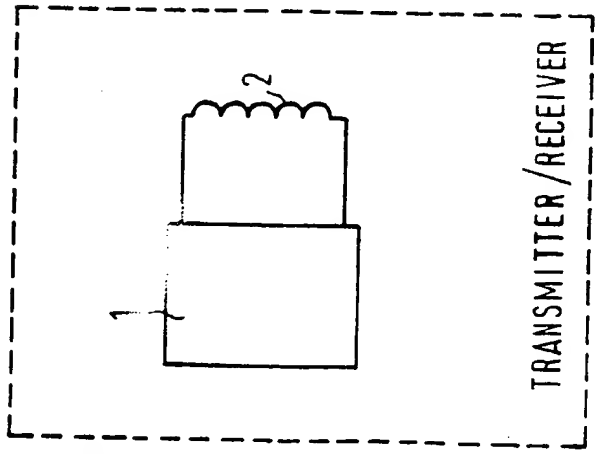


FIG.1

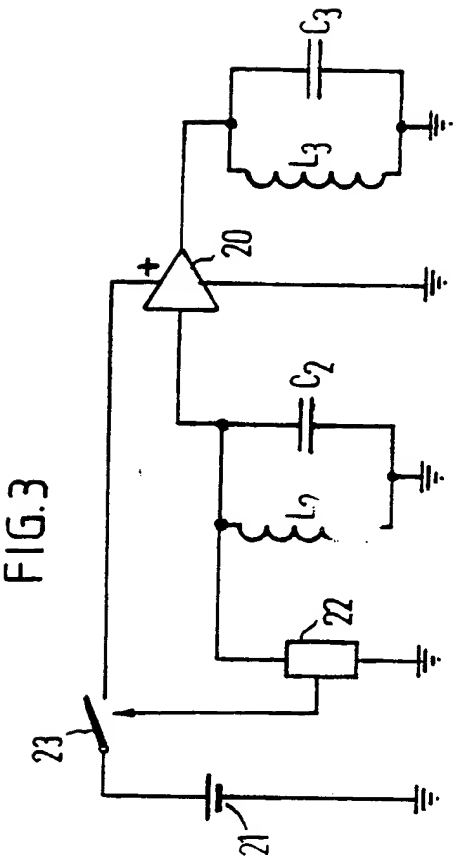


FIG.3

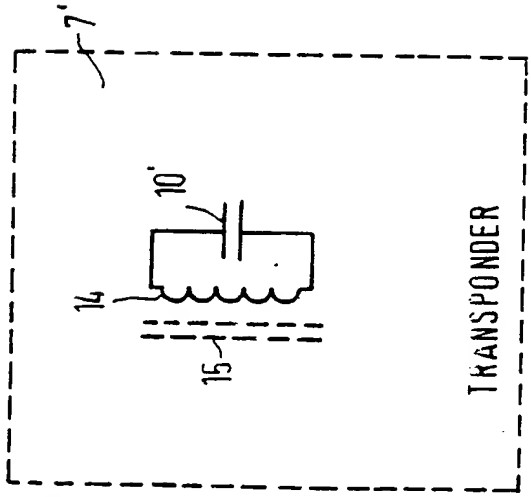


FIG.2

FIG.4

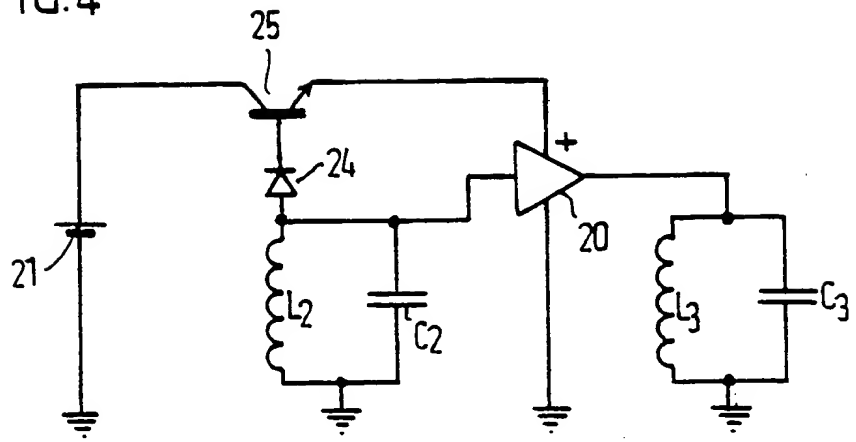
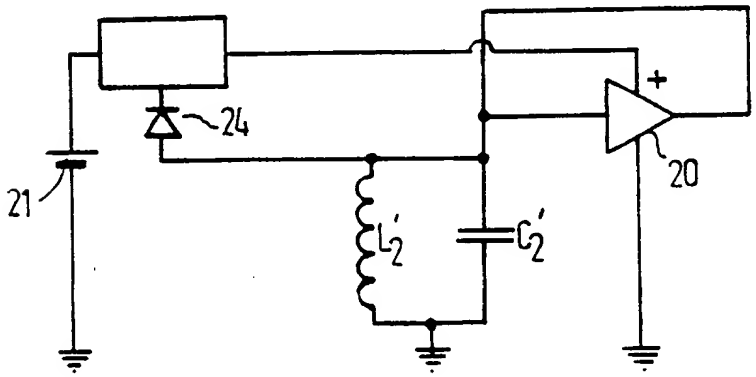


FIG.5



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EUROPEAN SEARCH REPORT

Application Number

EP 88 20 1358

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A,D	NL-A-7 810 245 (BRON) * Page 1, lines 1-9,24-28; page 3, lines 9-17; page 4, lines 7-13 *	1-5,12, 13	A 01 K 11/00 G 01 S 13/00

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A 01 K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-10-1988	VILBIG K

CATEGORY OF CITED DOCUMENTS

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